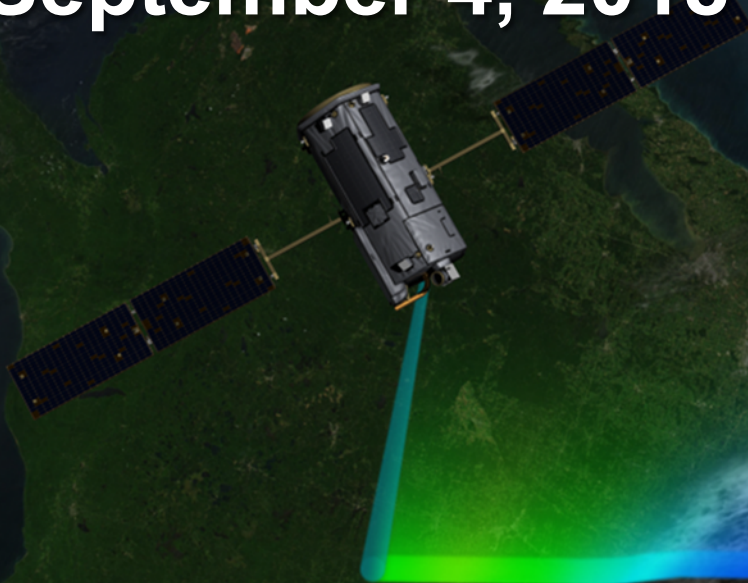




# OCO-2 Status September 4, 2018



David Crisp, for the OCO-2 Team

Jet Propulsion Laboratory, California Institute of Technology

September 4, 2018



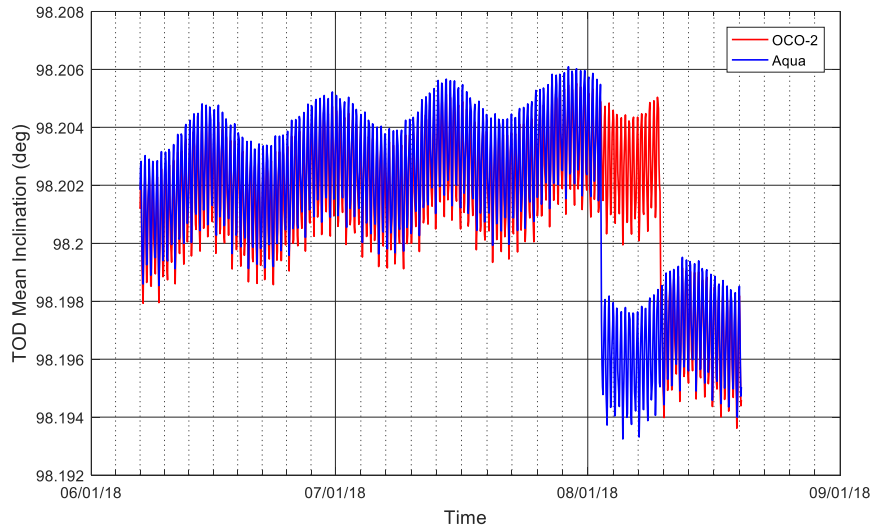
# Status Summary

- **Observatory Status: Nominal**
  - Inclination adjust maneuver performed on 9 August 2018 to realign with Aqua, after it had to perform a large Risk Mitigation Maneuver on 11 July 2018
  - Next DMUM depends on CALIPSO
    - If CALIPSO does not leave the A-Train in mid-Sept, next DMUM ~27 Sept
    - If CALIPSO leaves the A-Train in mid-Sept, next DMUM ~30 Sept
  - Formation flying overlap expected to be 100% through this cycle
- **Instrument Status: Nominal**
  - Next Decontamination Cycle targeted for late October/early November
  - Bad Pixel Map 11 upload on 9 August 2018
- **Science Status: Nominal**
  - “Version 9” Lite file updates (geolocation, met re-sampler fix)
  - ACOS GOSAT V8 processing
  - Plans for October 23-25 Science Team Meeting advancing

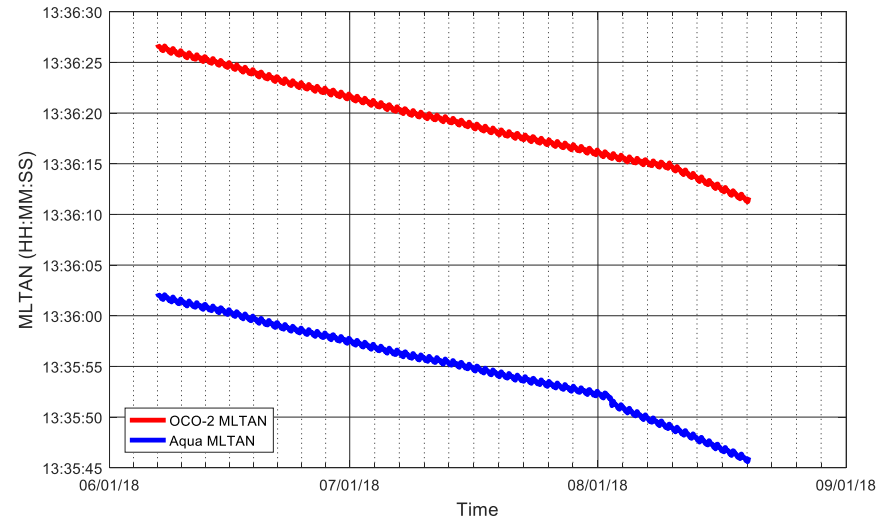




# Inclination Adjustment to Track Aqua

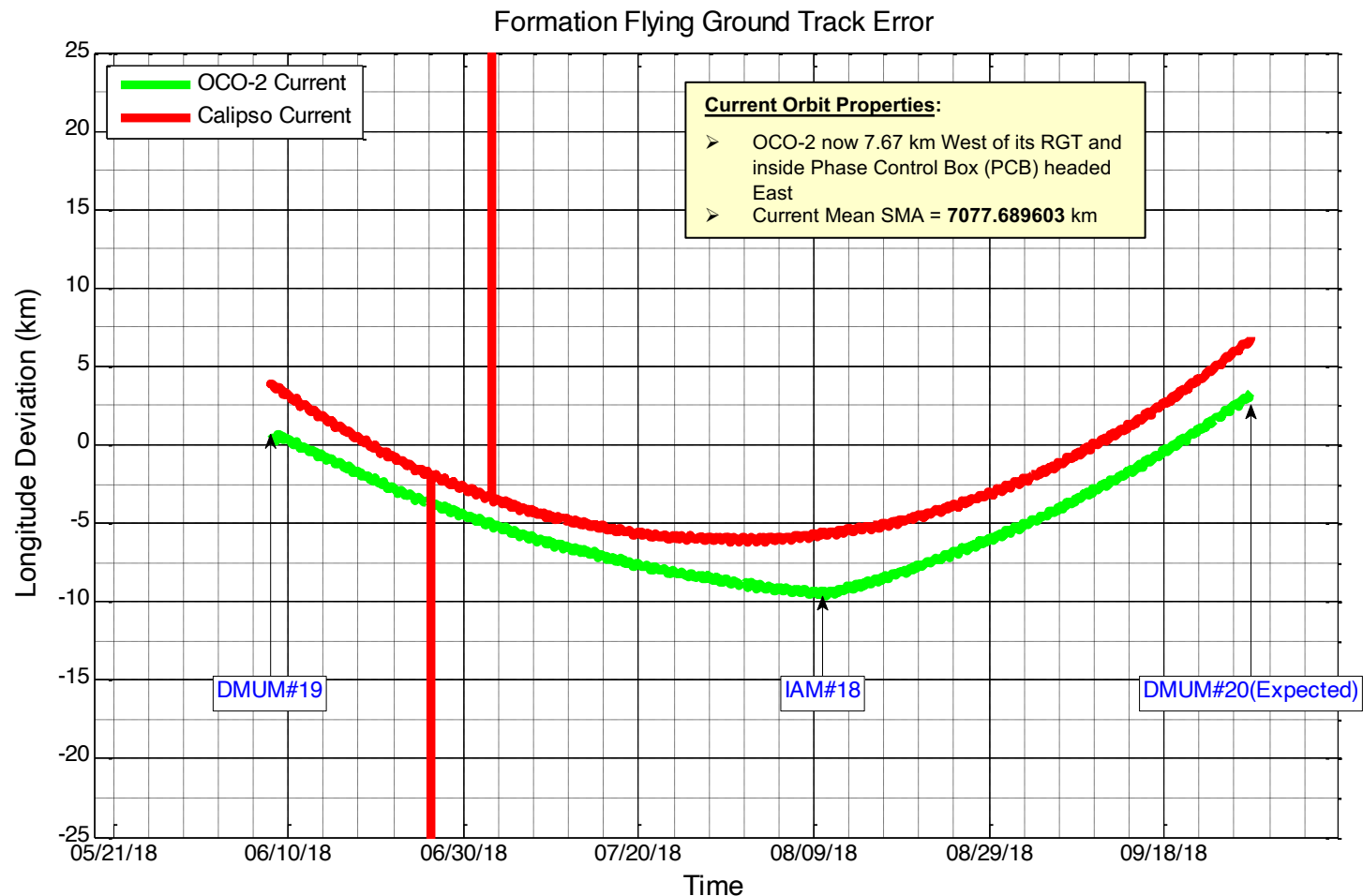


OCO-2 executed an inclination adjust maneuver on August 9 to realign with Aqua, after Aqua performed a Risk Mitigation maneuver on July 11.





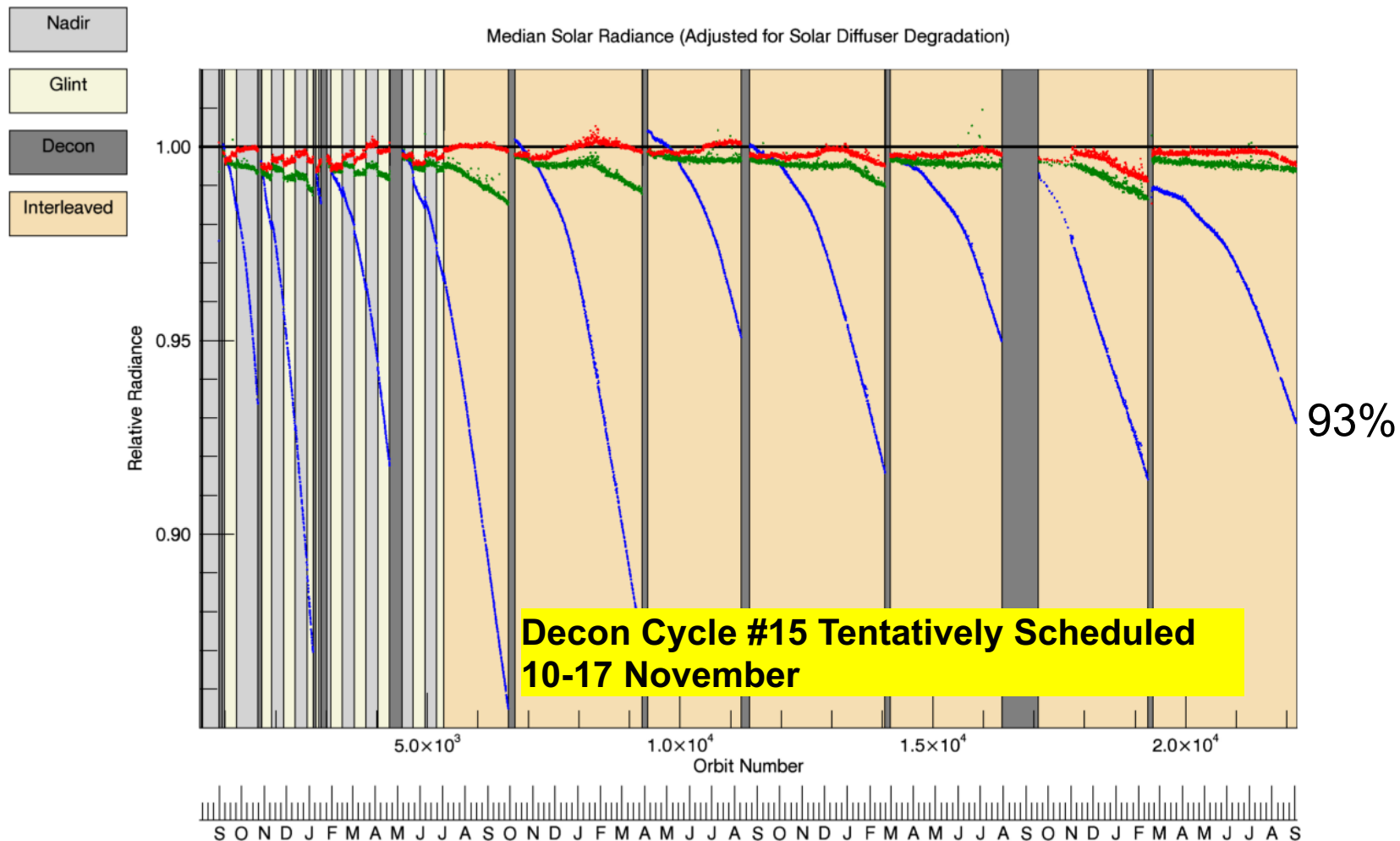
# OCO-2/CALIPSO Ground Track Overlap





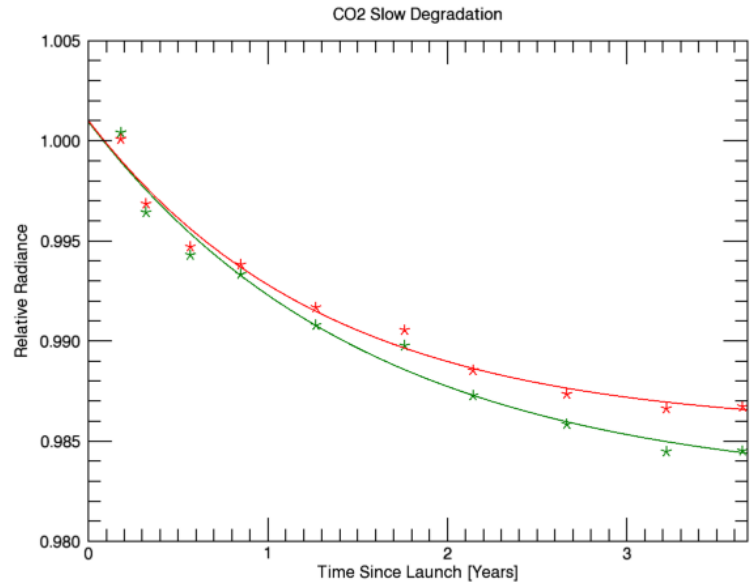
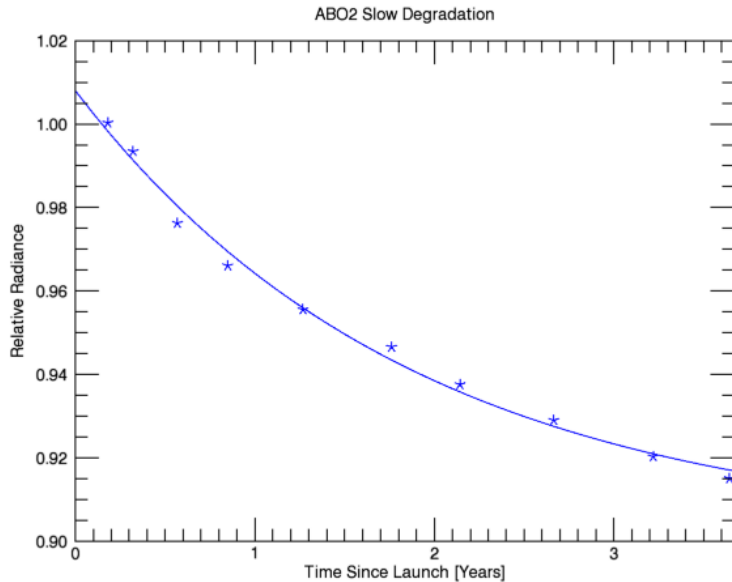
# Contamination Trending

## A-band Currently at 93%





# Slow Degradation Continuing to Follow Trend



The slow throughput degradation rate continues to decrease.



# Bad Pixel Map Upload

## The Plan:

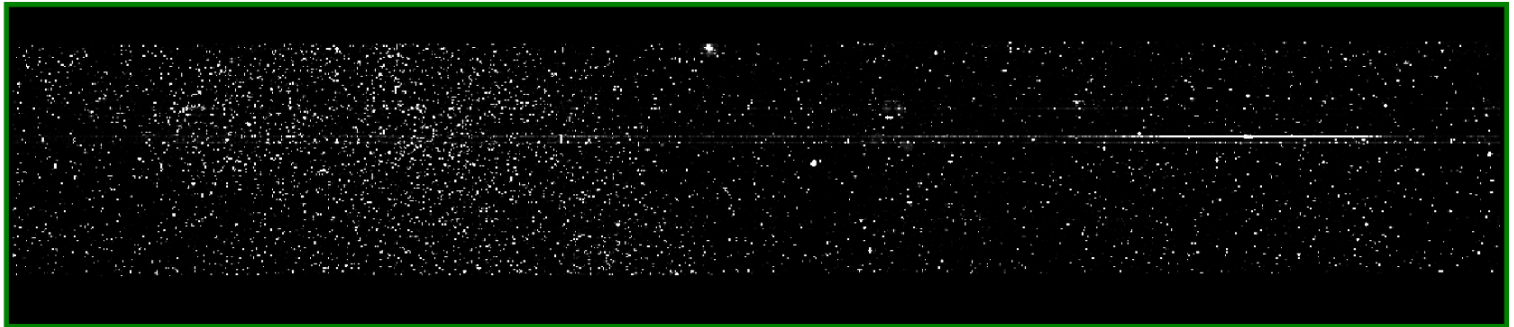
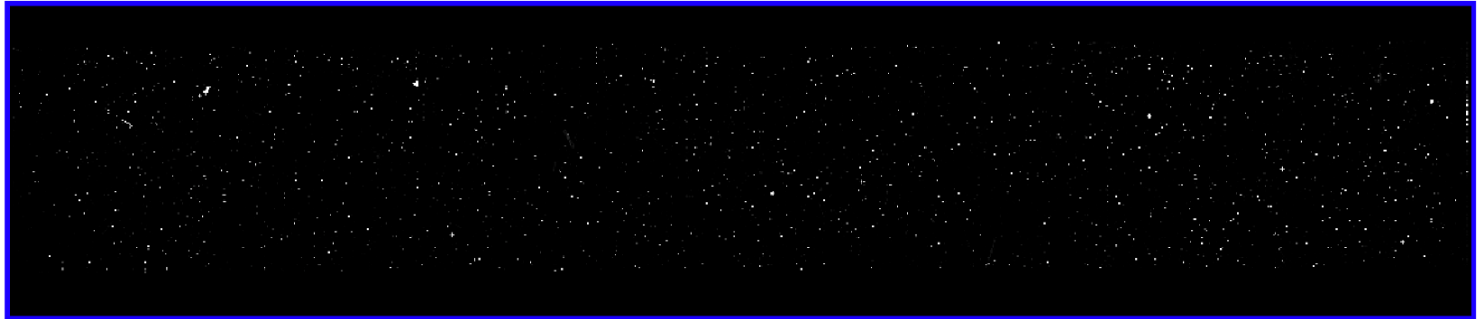
- Bad pixel maps identify pixels on each focal plane array (FPA) that are dead, or whose performance is substantially different than their neighbors.
- A few hundred of the ~160,000 “science” pixels on each FPA have gone bad since the last BPM update in February 2015.
- These pixels must be eliminated from the 20-pixels sums that are performed on-board to create the “summed” spectra that are downlinked.
- Over the past few months, OCO-2 calibration team members Rob Rosenberg and Yulia Marchetti developed and implemented advanced algorithms for identifying bad pixels.
- That process was completed and the new maps were approved for upload on Wednesday August 8. The upload commands were reviewed and approved and the upload was scheduled for Thursday, August 9





# Bad Pixel Map 11 (BPM 11)

Log Scale with Existing BPs On

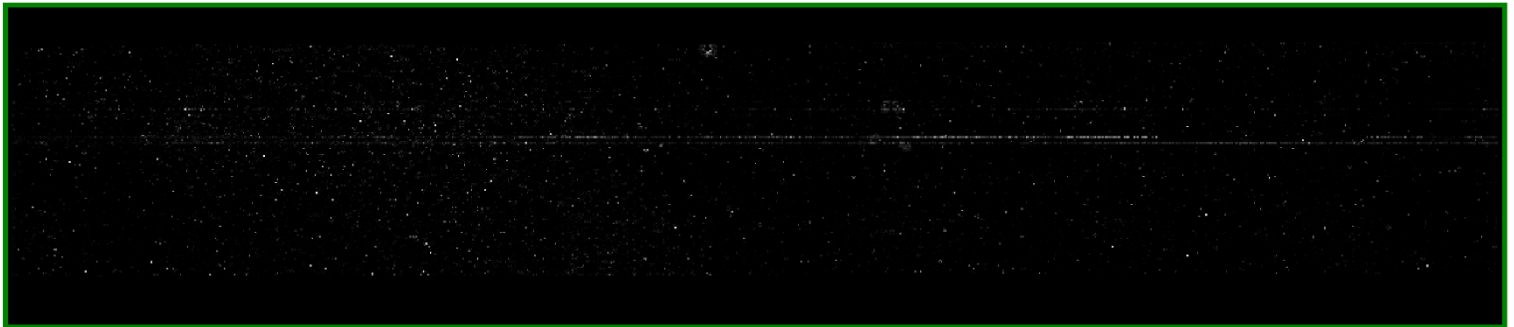






# Changes from BPM 10 to BPM 11

Log Scale with Existing BPs Off





# Bad Pixel Map Upload Anomaly

- The bad pixel map upload process did not complete as expected.
  - Bad pixel maps were successfully uploaded and activated for all 3 spectrometers on orbit number 21832
  - Immediately after the upload, the Oxygen A-band (ABO2) channel's data processor, DP2 issued an *emergency off* command followed by a *Reset* command
    - For orbit 21833, the ABO2 channel was off. A *standby* command running as part of a background sequence turned it back on
- The anomaly team found that DP2 returned to normal operations and that Bad Pixel Map 11 had apparently loaded properly, but with two errors:
  - The bad pixel map number was set to 0 instead of 11
  - The clocking parameters, which establish the footprint boundaries, were set to zero rather than their nominal values
- With the clocking parameters loaded incorrectly, the ABO2 summed data were inconsistent with the pre-launch and on-orbit calibration data



# Resolution of the Bad Pixel Map Upload Anomaly

- The following range of orbits were lost and cannot be recovered:
  - Orbit 21833; 2018-08-09T12:28:52.142Z
  - Orbit 21876; 2018-08-12T12:59:44.295Z

The anomaly team issued a *Set Default State* command to on orbit 21877 to reload the clocking parameters. The command executed successfully

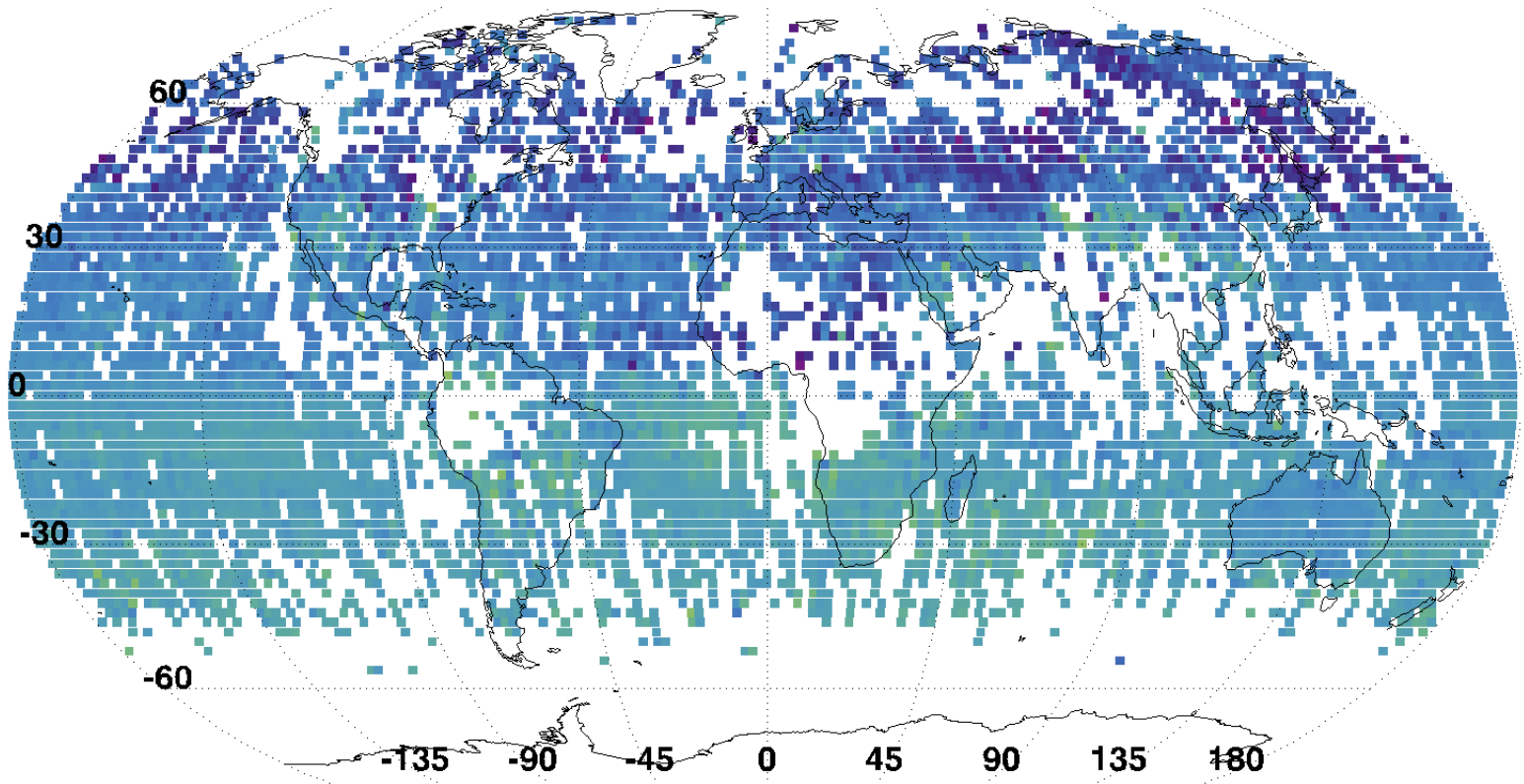
**The system is now collecting and processing data normally**

- Ongoing work:
  - The Forward processing stream restarted with Orbit 21936
  - An initial review of the data quality from Orbits 21936-21995 showed generally improved performance, but poor fits (high  $\chi^2$  values) especially in WCO2 FP 8
    - Addressed by adding 10 additional bad samples starting with 21996
- No general bad sample lists updates were implemented – awaiting B10.
- Investigation of root cause of DP2 *emergency off* command is ongoing



# August $X_{CO_2}$ (V8 forward stream)

Mean  $X_{CO_2}$  - Aug 2018



Mean  $X_{CO_2}$  (ppm)

395.000

401.250

407.500

413.750

420.000

1 Sep 2018  
Ops\_B8100\_r0x





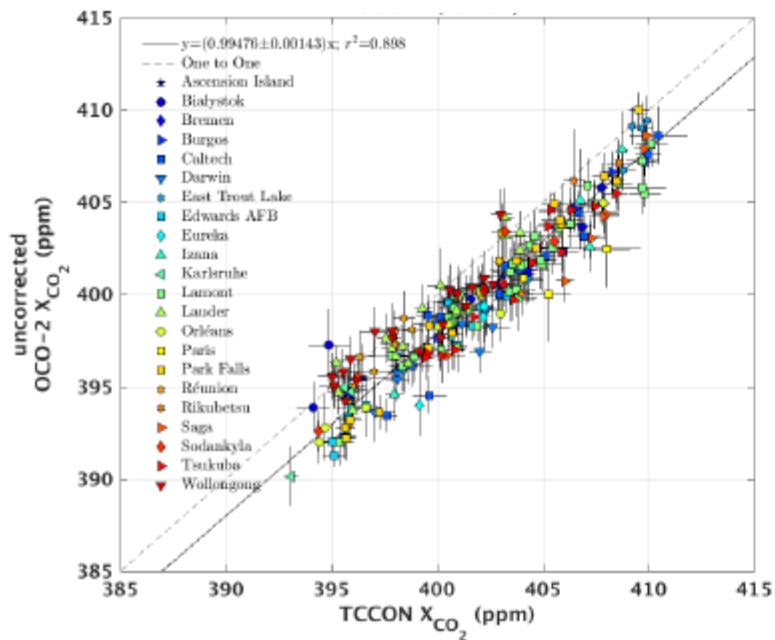
# B9 Progress

- Chris O'Dell
  - Made minor updates to the screening and created filter plots for tccon, small area, and multi-model mean
    - the validation/filter plots are available here:  
[http://reef.atmos.colostate.edu/~odell/oco2/b9\\_tests/filter\\_plots/](http://reef.atmos.colostate.edu/~odell/oco2/b9_tests/filter_plots/)
  - Created an off-line version of the entire B9 dataset, through July 31, 2018 and **requested help reviewing the products ASAP**. Files are here:
    1. [http://reef.atmos.colostate.edu/~odell/oco2/b9\\_tests/lite\\_B9aTest/daily/](http://reef.atmos.colostate.edu/~odell/oco2/b9_tests/lite_B9aTest/daily/)
    2. [soot.jpl.nasa.gov/home/odell/OCO2\\_results/lite\\_test\\_2018031/](http://soot.jpl.nasa.gov/home/odell/OCO2_results/lite_test_2018031/) (via ssh/scp)
    3. [ocomaster.cira.colostate.edu/home/codell/OCO2\\_results/lite/lite\\_test\\_20180831/](http://ocomaster.cira.colostate.edu/home/codell/OCO2_results/lite/lite_test_20180831/) (via ssh/scp)
  - See Chris for log-in info for reef if you do not have an account on the OCO-2 cluster
- V9 Production will start in “a few days”



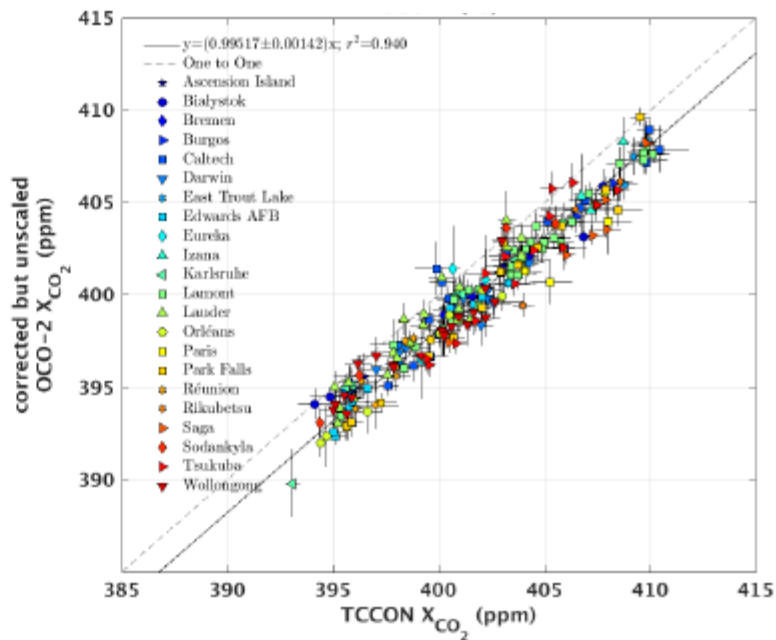
# B9 Validation Progress

## OCO-2 v8 Raw



With AK Correction  
slope: 0.99481

## OCO-2 v9



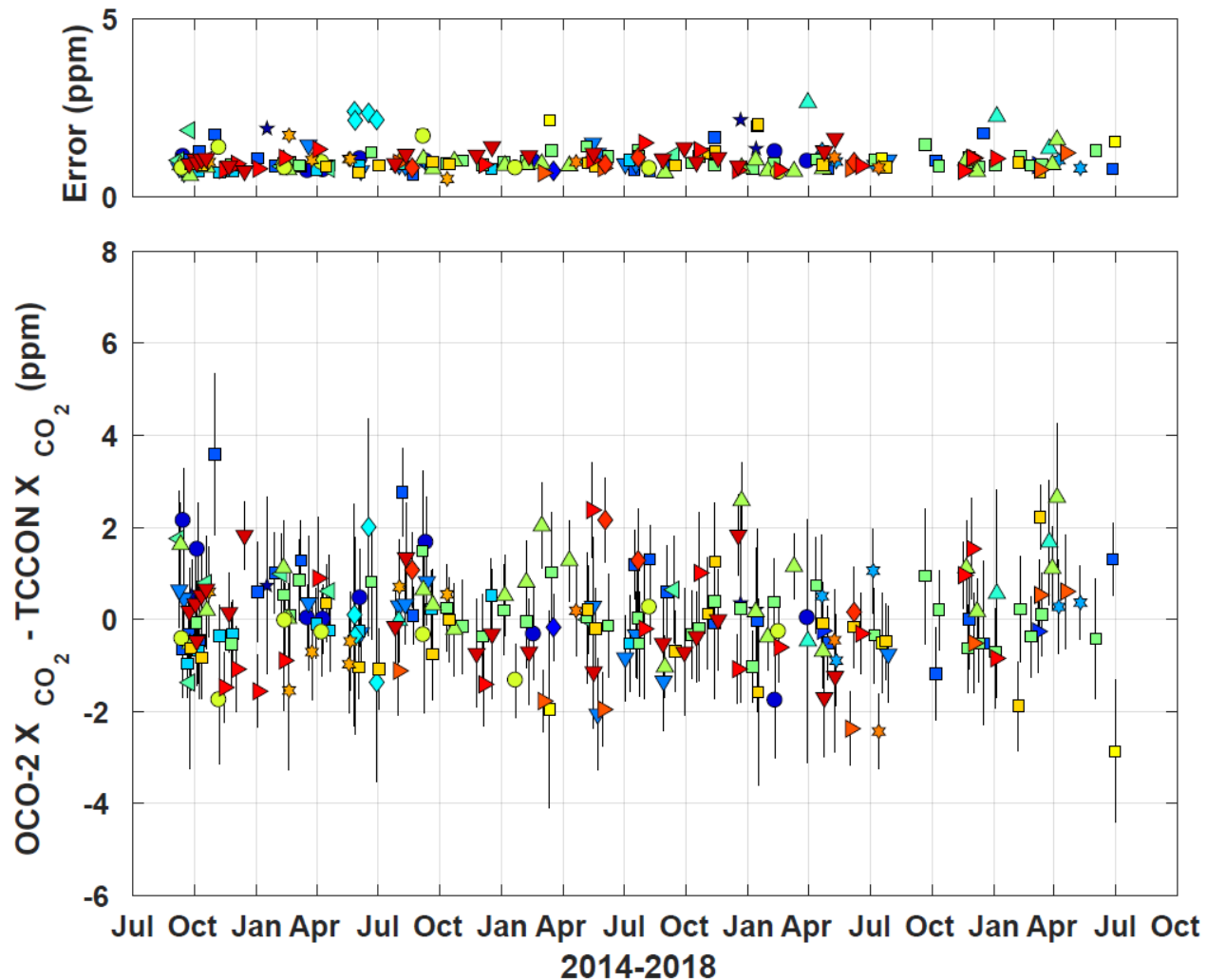
With AK Correction  
slope: 0.99528

Matt Kiel





# V9 Product vs TCCON over time

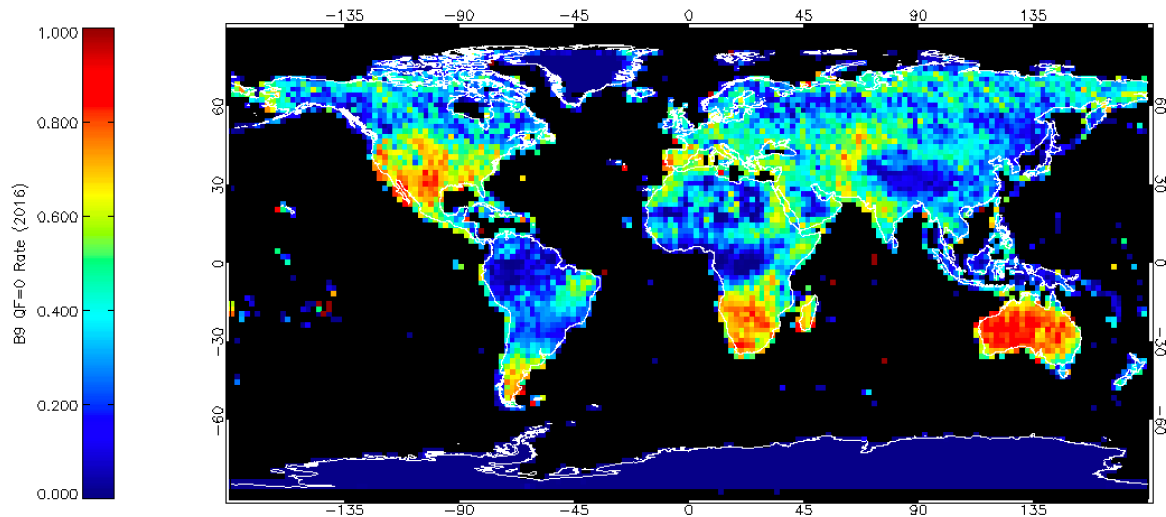


Matt Kiel

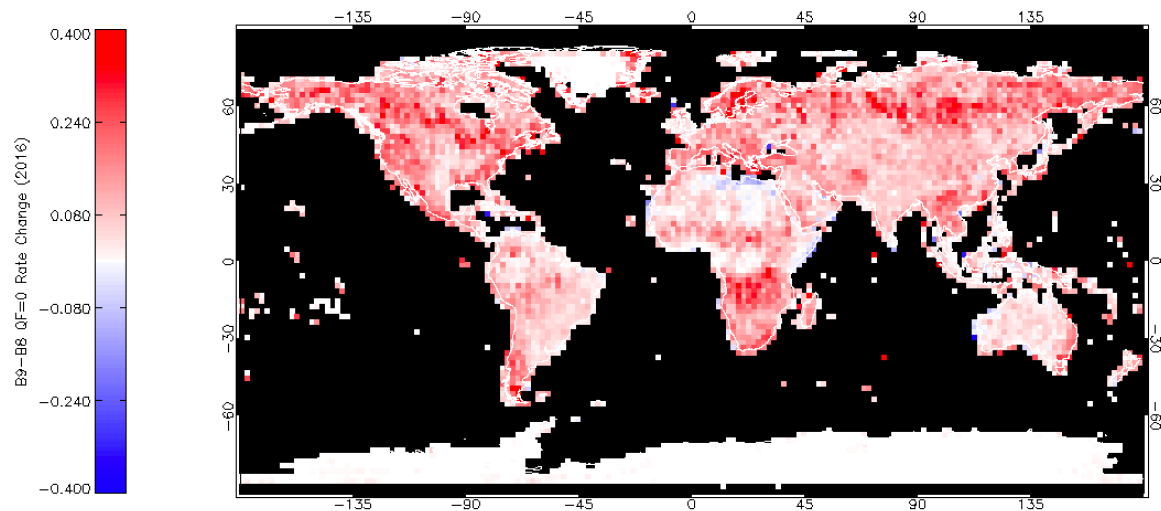


# V9 Has Higher Yields than V8

Chris O'Dell



V9 Yield for 2016  
(25 M soundings)

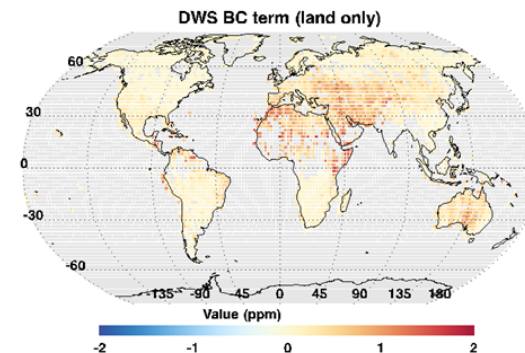
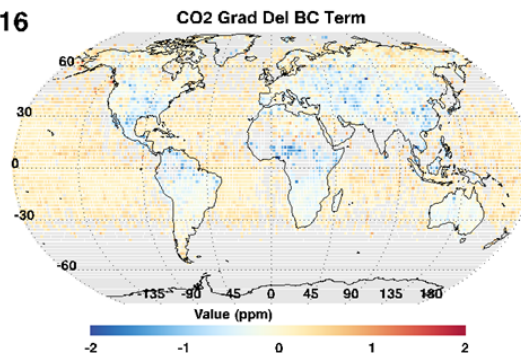
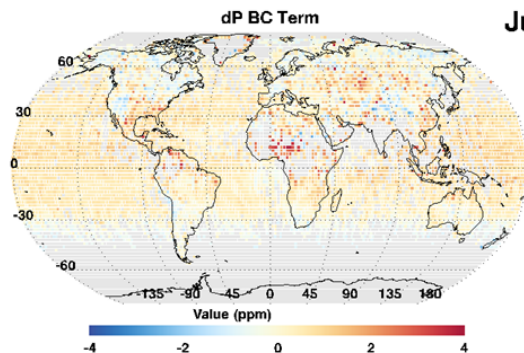
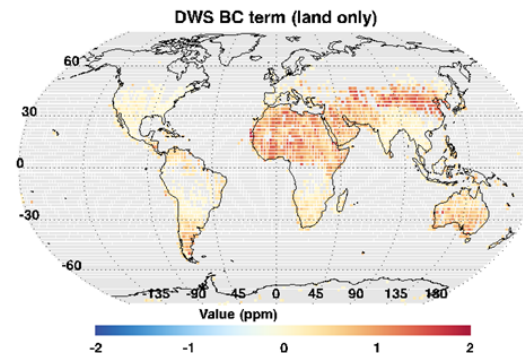
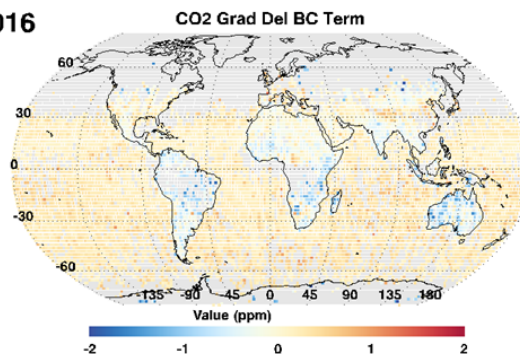
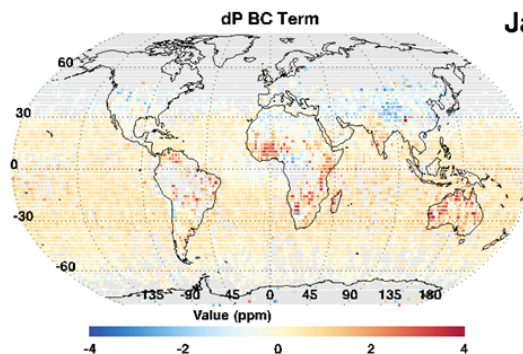


V9 - V8 Yield

Filters updated slightly  
in final product



# Amplitudes of B9 Bias Corrections





## V9 summary

- OCO-2 V9 Lite testing indicates that this product appears to have smaller errors and better coverage than the v8 product.
- Some of the added soundings have higher random errors and biases than those seen in the V8 Lite product
  - Some of the largest increases in yield and biases and random errors are seen at high latitudes
  - These soundings are currently under investigation
  - The screening criteria may be modified before we process the entire dataset.



# Publications Statistics

As of **4-Sept-2018**:

## Published

- 2014: OCO-2: 7 refereed papers, 1 book chapter
- 2015: OCO-2: 8 refereed papers
- 2015: ACOS: 3 refereed papers, 1 book chapter
- 2016: OCO-2: 18 refereed papers
- 2016: ACOS: 12 refereed papers
- 2017: OCO-2: 48 refereed papers
- 2017: ACOS: 2 refereed papers
- 2018: OCO-2: **15** refereed papers
- 2018 ACOS: **2** refereed papers

## In Review

- 2018 OCO-2: 3 papers



# Publications

## New Publications:

- Wu, L., Hasekamp, O., Hu, H., Landgraf, J., Butz, A., aan de Brugh, J., Aben, I., Pollard, D. F., Griffith, D. W. T., Feist, D. G., Koshelev, D., Hase, F., Toon, G. C., Ohyama, H., Morino, I., Notholt, J., Shiomi, K., Iraci, L., Schneider, M., de Mazière, M., Sussmann, R., Kivi, R., Warneke, T., Goo, T.-Y., and Té, Y.: Carbon dioxide retrieval from OCO-2 satellite observations using the RemoTeC algorithm and validation with TCCON measurements, *Atmos. Meas. Tech.*, 11, 3111-3130, <https://doi.org/10.5194/amt-11-3111-2018>, 2018.
- Yang, Z., Zhen, Y. , Yin, Z., Lin, C., Bi, Y., Liu, W., Wang, Q., Wang, L., Gu, S., and Tian, L.: Laboratory spectral calibration of the TanSat atmospheric carbon dioxide grating spectrometer, *Geosci. Instrum. Method. Data Syst.*, 7, 245–252, 2018, doi:10.5194/gi-7-245-2018

## Papers in Review:

- Ye et al., Constraining fossil fuel CO<sub>2</sub> emissions from urban area using OCO-2 observations of total column CO<sub>2</sub>, *ATMOSPHERIC CHEMISTRY AND PHYSICS Discussions*, Submitted 1 Nov 2017.
- Hakkarainen et al., Global XCO<sub>2</sub> anomalies as seen by Orbiting Carbon Observatory-2, *ATMOSPHERIC CHEMISTRY AND PHYSICS Discussions*, submitted 28 June 2018.
- O'Dell et al., Improved Retrievals of Carbon Dioxide from the Orbiting Carbon Observatory-2 with the version 8 ACOS algorithm, *Atmos. Meas. Tech. Discuss.*, submitted 27 July 2018.





# OCO-2 Fall 2018 Science Team Meeting

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- The Fall 2018 OCO-2/3 Science Team Meeting will be held at the NCAR Mesa Facility in Boulder Colorado on October 23-25, 2018
  - Breakouts the morning of Tues, Oct 23rd.
  - Full plenary meeting (with posters) the afternoon of Tues the 23rd and all day Wed and Thurs, 10/24 and 10/25.
  - Field trip to Niwot Ridge for those interested on the morning of Friday, Oct 26th. Troy Magney is organizing.
- Meeting Web site: <https://sites.google.com/view/oco2stm1018/home>
  - This site includes a draft agenda a Registration page, and some location and logistical information.

If you are planning to attend, please register here:

<https://sites.google.com/view/oco2stm1018/register>

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# Near Term Key Planned Activities

Planned Date	Activity Description
17-20 Sep 2018	IG3IS/TRANSCOM workshop, Lund Sweden
23-25 Oct 2018	OCO-2 Science Team meeting in Boulder, CO
6-7 Nov 2018	End of Year Mission Ops Review in Dulles, VA
10-17 Nov (TBC)	OCO-2 Decon Cycle # 15
4-6 Dec 2018	Fall MOWG at Goddard Space Flight Center
10-14 Dec 2018	Fall AGU, Washington, DC
12 Dec 2018 (TBC)	OCO-2/GOSAT TIM at AGU
6-10 Jan 2019	99 <sup>th</sup> Annual AMS Meeting, Phoenix, AZ
17 Feb 2019 (TBC)	OCO-3 Launch, Cape Canaveral, FL
7-12 Apr 2019	EGU General Assembly, Vienna
4-6 Jun 2019	IWGGMS-15, Sapporo, Hokkaido